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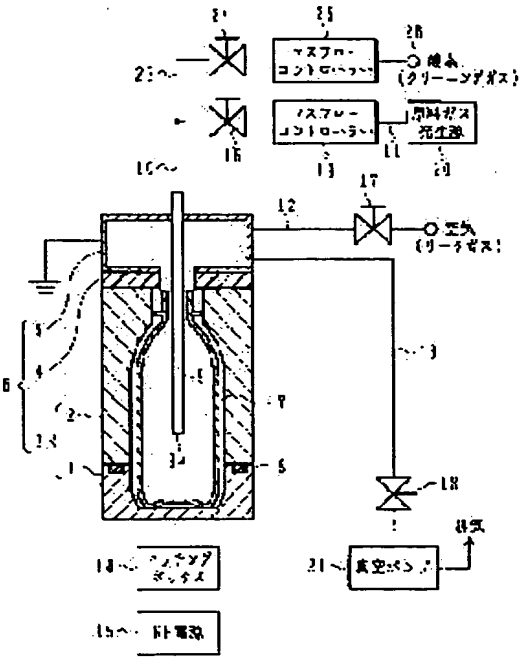
(54) SYSTEM AND METHOD FOR CVD FILM DEPOSITION

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a CVD film deposition system, in which the peeling off of a thin film adhering to an internal electrode and its falling down onto the inside of a container can be prevented, keeping the system availability.
SOLUTION: The CVD film deposition system has: an external electrode 3 arranged in a manner to enclose the outside of a PET (polyethylene terephthalate) bottle 7; an internal electrode 9 arranged inside the external electrode 3 and also inside the PET bottle 7; a source-gas-introducing means for introducing source gas into the inside of the PET bottle; a gas-introducing means for introducing cleaning gas into the inside of the external electrode 3; a matching box 14 connected to the external electrode 3; and an RF power source 15 connected to the matching box. The gas is introduced into the external electrode by the gas-introducing means and the RF output is supplied by the RF power source via the matching box to the external electrode to produce plasma between the internal electrode and the external electrode, by which the thin film adhering to the internal electrode can be decomposed and removed.



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CLAIMS

[Claim(s)]
[Claim 1] The external electrode which is CVD membrane formation equipment which forms a thin film inside a container, and has been arranged so that the outside of a container may be surrounded, The internal electrode which is arranged in this external electrode and arranged inside a container, and a material gas installation means to introduce material gas into the interior of a container, CVD membrane formation equipment characterized by providing a gas installation means to introduce the gas for cleaning into the interior of the above-mentioned external electrode, the matching box connected to the external electrode, and the RF generator connected to this matching box.
[Claim 2] CVD membrane formation equipment according to claim 1 characterized by disassembling and removing the thin film which adhered to the internal electrode by introducing gas in the above-mentioned external electrode by the above-mentioned gas installation means, and a RF output's being supplied to an external electrode by the above-mentioned RF generator through a matching box, and generating the plasma between the above-mentioned internal electrode and an external electrode.
[Claim 3] The gas for the above-mentioned cleaning is CVD membrane formation equipment according to claim 1 or 2 characterized by being one gas chosen from the group which consists of mixed gas of the mixed gas of oxygen gas, oxygen gas, and argon gas, the etching gas of a fluorine system, and oxygen gas and the etching gas of a fluorine system.
[Claim 4] By arranging the internal electrode of ground potential inside a container, arranging an external electrode to the exterior of this container, supplying material gas in a container, supplying a RF output to an external electrode, and generating the material gas system plasma between an internal electrode and an external electrode The 1st process which forms a thin film to the inside of a container, and the 2nd process which removes the thin film which adhered to the internal electrode according to this 1st process by ashing are provided. The 2nd process of the above The CVD membrane formation approach characterized by being the process which disassembles and removes the thin film which adhered to the internal electrode by introducing gas in an external electrode, supplying energy to an external electrode, and generating the plasma between an internal electrode and an external electrode.
[Claim 5] The above-mentioned gas is the CVD membrane formation approach according to claim 4 characterized by being one gas chosen from the group which consists of mixed gas of the mixed gas of oxygen gas, oxygen gas, and argon gas, the etching gas of a fluorine system, and oxygen gas and the etching gas of a fluorine system.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the CVD membrane formation equipment and the CVD membrane formation approach which are the CVD membrane formation equipment and the CVD membrane formation approach of forming a thin film, and were equipped with the cleaning device inside the container.
[0002]
[Description of the Prior Art] Conventional CVD (Chemical Vapor Deposition) membrane formation equipment is equipment which forms the DLC (Diamond Like Carbon) film or the Si content DLC film to the insides, such as a container, using a plasma-CVD method. The DLC film is amorphous carbon which made SP3 association between carbon the subject, and is hard carbon film which is very hard, is excellent in insulation, and has very smooth mol FOROJI with a high refractive index. Si content hydrocarbon system gas is used as material gas which forms the Si content DLC film, using hydrocarbon system gas as material gas which forms the DLC film.
[0003] Conventional CVD membrane formation equipment is equipped with a vacuum chamber, and this vacuum chamber has the external electrode. Space is formed in the interior of this external electrode, and this space is for holding the PET bottle which is a plastic envelope for coating. The external electrode is connected to the impedance matching box (matching box), and the matching box is connected to the RF generator (RF power source) through the coaxial cable.
[0004] The internal electrode is fitted over the space in an external electrode, and the tip of an internal electrode is arranged inside the PET bottle which is the space in an external electrode and was held in the external electrode. The internal electrode has the tubing configuration which the interior becomes from hollow. The gas diffuser is formed at the tip of an internal electrode. The end face of an internal electrode is connected to the gas installation means.
[0005] The internal electrode is grounded. Space in an external electrode is made into the atmospheric-air disconnection condition through the vacuum bulb. Moreover, the space in an external electrode is connected to the vacuum pump.
[0006] Next, how to form the DLC film inside a container using the above-mentioned CVD membrane formation equipment is explained.
[0007] First, a vacuum bulb is opened and atmospheric-air disconnection of the inside of a vacuum chamber is carried out. Thereby, air goes into the space in an external electrode, and the inside of a vacuum chamber is made into atmospheric pressure. Next, a PET bottle is held in the space in an external electrode. Under the present circumstances, it will be inserted by the internal electrode into a PET bottle.
[0008] Then, after closing a vacuum bulb, by operating a vacuum pump, the inside of a vacuum chamber including the inside of a PET bottle is exhausted, and the space in an external electrode serves as a vacuum.
[0009] Next, the hydrocarbon gas by which control of flow was carried out using the gas installation means is blown off from a gas diffuser through the internal electrode of ground potential. Thereby, hydrocarbon gas is introduced in a PET bottle. And the inside of a vacuum chamber and a PET bottle is maintained at the controlled quantity of gas flow and the pressure which was suitable for DLC membrane formation with the balance of exhaust air capacity.
[0010] Then, RF output is supplied to an external electrode from an RF generator (RF power source) through a matching box. This lights the plasma between an external electrode and an internal electrode. At this time, the matching box is set by the impedance of an external electrode and an internal electrode with an inductance L and capacitance C. The hydrocarbon system plasma occurs in a PET bottle, and the DLC film is formed inside a PET bottle by this.
[0011] Next, RF output from RF power source is suspended, and supply of material gas is suspended. Then, the hydrocarbon gas in a vacuum chamber and a PET bottle is exhausted with a vacuum pump. Then, the DLC film is formed in two or more PET bottles by opening a vacuum bulb and repeating the membrane formation approach

which carried out atmospheric-air disconnection and mentioned the inside of a vacuum chamber above.
[0012]
[Problem(s) to be Solved by the Invention] By the way, in the above-mentioned conventional CVD membrane formation equipment, if the DLC film is formed to the inside of a PET bottle, the DLC film will be formed by the outside surface of an internal electrode. For this reason, the thickness of the DLC film formed by the outside surface of an internal electrode when membrane formation of the DLC film into two or more PET bottles was repeated becomes thick gradually, and if it becomes thickness (for example, thickness of about 5 micrometers) with that thickness, it will separate and will fall from an internal electrode. With the DLC film which fell into the PET bottle, consequently fell into the PET bottle, the part which is not formed in that PET bottle will arise, and this DLC film that separated and fell will reduce gas barrier property, and will become a defective.
[0013] The following approach can be considered to, prevent that the DLC film separates and falls from the outside surface of an internal electrode into a PET bottle on the other hand. That is, it is the approach are before the DLC film formed by the outside surface of an internal electrode separates and falls, and an operator does deleting by the file etc. and cleans the outside surface of the internal electrode to which CVD membrane formation equipment was disassembled, the internal electrode was removed, and the DLC film has adhered after forming the DLC film in the PET bottle of a certain amount of number. Thus, if the outside surface of an internal electrode is cleaned, it should be able to prevent that the DLC film separates and falls into a PET bottle.
[0014] If such an approach is used, it can be prevented that the DLC film separates and falls into a PET bottle. However, whenever it cleans an internal electrode, the CVD membrane formation equipment which is working must be stopped upwards, CVD membrane formation equipment will be disassembled, an internal electrode will be cleaned, and the activity of assembling CVD membrane formation equipment after that will also take a long time (for example, about one day). Consequently, the operating ratio of CVD membrane formation equipment will fall, and it will become the failure of mass production.
[0015] It is in offering the CVD membrane formation equipment and the CVD membrane formation approach of this invention being made in consideration of the above situations, and the purpose preventing that the thin film adhering to an internal electrode separates and falls into a container, and controlling decline in the operating ratio of equipment.
[0016]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the CVD membrane formation equipment concerning this invention The external electrode which is CVD membrane formation equipment which forms a thin film inside a container, and has been arranged so that the outside of a container may be surrounded, The internal electrode which is arranged in this external electrode and arranged inside a container, and a material gas installation means to introduce material gas into the interior of a container, It is characterized by providing a gas installation means to introduce the gas for cleaning into the interior of the above-mentioned external electrode, the matching box connected to the external electrode, and the RF generator connected to this matching box.
[0017] Moreover, in the CVD membrane formation equipment concerning this invention, it is possible by introducing gas in the above-mentioned external electrode by the above-mentioned gas installation means, and a RF output's being supplied to an external electrode by the above-mentioned RF generator through a matching box, and generating the plasma between the above-mentioned internal electrode and an external electrode to disassemble and remove the thin film adhering to an internal electrode.
[0018] According to the above-mentioned CVD membrane formation equipment, the plasma is generated between an internal electrode and an external electrode, and ashing can remove the thin film adhering to an internal electrode. Therefore, it can prevent the thin film adhering to an internal electrode separating, and falling into a container. Moreover, in order to remove the thin film with which CVD membrane formation equipment adhered to the internal electrode by having such a cleaning device, it is not necessary to disassemble CVD membrane formation equipment. Therefore, decline in the operating ratio of CVD membrane formation equipment can be controlled.
[0019] Moreover, as for the gas for the above-mentioned cleaning, in the CVD membrane formation equipment concerning this invention, it is possible for it to be also one gas chosen from the group which consists of mixed gas of the mixed gas of oxygen gas, oxygen gas, and argon gas, the etching gas of a fluorine system, and oxygen gas and the etching gas of a fluorine system. In addition, as etching gas of a fluorine system, it is also possible to use CH2F2, CF4, and SiF6 grade, for example.
[0020] The CVD membrane formation approach concerning this invention arranges the internal electrode of ground potential inside a container. By arranging an external electrode to the exterior of this container, supplying material gas in a container, supplying a RF output to an external electrode, and generating the material gas system plasma between an internal electrode and an external electrode The 1st process which forms a thin film

to the inside of a container, and the 2nd process which removes the thin film which adhered to the internal electrode according to this 1st proc[redacted]y ashing are provided. The 2nd proce[redacted]f the above It is characterized by being the process which disassembles and removes the thin film adhering to an internal electrode by introducing gas in an external electrode, supplying energy to an external electrode, and generating the plasma between an internal electrode and an external electrode.

[0021] Moreover, as for the above-mentioned gas, in the CVD membrane formation approach concerning this invention, it is possible for it to be also one gas chosen from the group which consists of mixed gas of the mixed gas of oxygen gas, oxygen gas, and argon gas, the etching gas of a fluorine system, and oxygen gas and the etching gas of a fluorine system. In addition, as etching gas of a fluorine system, it is also possible to use CH2F2, CF4, and SiF6 grade, for example.

[0022]

[Embodiment of the Invention] Hereafter, the gestalt of 1 operation of this invention is explained with reference to a drawing. The CVD membrane formation equipment by the gestalt of operation of this invention is equipment which forms the DLC film or the Si content DLC film to the insides, such as a container, using a plasma-CVD method.

[0023] Drawing 1 is the block diagram showing typically the CVD membrane formation equipment by the gestalt of operation of this invention. This CVD membrane formation equipment has the vacuum chamber 6, and this vacuum chamber 6 consists of conductive covering devices 5, insulating members 4, and external electrodes 3. The insulating member 4 is arranged under the covering device 5, and the external electrode 3 is arranged under this insulating member 4. This external electrode 3 consists of an up electrode 2 and a lower electrode 1, and it is constituted so that the upper part of the lower electrode 1 may be attached in the lower part of the up electrode 2 free [attachment and detachment] through O ring 8. Moreover, the external electrode 3 is insulated with the covering device 5 by the insulating member 4.

[0024] Space is formed in the interior of the external electrode 3, and this space is for holding PET bottle 7 which is a plastic envelope for coating. The space in an external electrode is formed so that it may become large slightly rather than the appearance of PET bottle 7 held there. Opening connected with the space in an external electrode is prepared in the insulating member 4 and the covering device 5. Moreover, space is established in the interior of a covering device 5, and this space is connected with the space in an external electrode through the above-mentioned opening. The space in an external electrode is sealed from the outside with O ring 8 arranged between the up electrode 2 and the lower electrode 1.

[0025] The lower electrode 1 of an external electrode is connected to the impedance matching box (matching box) 14, and the matching box 14 is connected to RF generator (RF power source) 15 through the coaxial cable.

[0026] It lets the space in a covering device, and a covering device and opening of an insulating member pass from the upper part of a covering device 5, and the internal electrode 9 is fitted over the space in an external electrode. That is, the end face of an internal electrode 9 is arranged in the upper part of a covering device 5, and the tip of an internal electrode 9 is arranged inside PET bottle 7 which is the space in an external electrode and was held in the external electrode.

[0027] The internal electrode 9 has the tubing configuration which the interior becomes from hollow. Gas diffuser 9a is prepared at the tip of an internal electrode 9. The one side of piping 10 is connected to the end face of an internal electrode 9, and the other side of this piping 10 is connected to the one side of a massflow controller 19 through the vacuum bulb 16. The other side of a massflow controller 19 is connected to the material gas generation source 20 through piping 11. This material gas generation source 20 generates hydrocarbon gas etc.

[0028] Moreover, the other side of piping 10 is connected to piping 23, and this piping 23 is connected to the one side of a massflow controller 25 through the vacuum bulb 24. The other side of a massflow controller 25 is connected to the oxygen supplies (source of cleaning gas supply) 26, such as an oxygen cylinder. An oxygen supply 26 and massflow controller 25 grade act as an O2 cleaning device.

[0029] The internal electrode 9 is grounded through the covering device 5. The space in a covering device is connected to the one side of piping 12, and the other side of piping 12 is made into the atmospheric-air disconnection condition through the vacuum bulb 17. Moreover, the space in a covering device is connected to the one side of piping 13, and the other side of piping 13 is connected to the vacuum pump 21 through the vacuum bulb 18. This vacuum pump 21 is connected to the exhaust side.

[0030] Next, how to form the DLC film inside a container using the CVD membrane formation equipment shown in drawing 1 is explained.

[0031] First, the vacuum bulb 17 is opened and atmospheric-air disconnection of the inside of the vacuum chamber 6 is carried out. Thereby, air goes into the space in a covering device, and the space in an external electrode through piping 12, and the inside of the vacuum chamber 6 is made into atmospheric pressure. Next, the lower electrode 1 of an external electrode is removed from the up electrode 2, and PET bottle 7 is inserted

and installed in the space in an up electrode from the up electrode 2 bottom. Under the present circumstances, it will be inserted by the internal ele[illegible]e 9 into PET bottle 7. Next, the lowe[illegible]t of the up electrode 2 is equipped with the lower electrode 1, and the external electrode 3 is sealed with O ring 8.

[0032] Then, after closing the vacuum bulb 17, the vacuum bulb 18 is opened and a vacuum pump 21 is operated. The inside of a vacuum chamber including the inside of PET bottle 7 (space in an external electrode and space in a covering device) is exhausted through piping 13 by this, and the inside of an external electrode serves as a vacuum.

[0033] Next, the vacuum bulb 16 is opened, hydrocarbon gas is generated in the material gas generation source 20, this hydrocarbon gas is introduced in piping 11, and the hydrocarbon gas by which control of flow was carried out with the massflow controller 19 is blown off from gas diffuser 9a through the internal electrode 9 of piping 10 and ground potential. Thereby, hydrocarbon gas is introduced in PET bottle 7. And the inside of a vacuum chamber and a PET bottle is maintained at the controlled quantity of gas flow and the pressure (for example, 0.05 – 0.5Torr extent) which was suitable for DLC membrane formation with the balance of exhaust air capacity.

[0034] Then, RF output (for example, 13.56MHz) is supplied to the external electrode 3 from RF generator (RF power source) 15 through a matching box 14. This lights the plasma between the external electrode 3 and an internal electrode 9. At this time, the matching box 14 is set by the impedance of an external electrode and an internal electrode with an inductance L and capacitance C. The hydrocarbon system plasma occurs in a PET bottle, and the DLC film is formed inside a PET bottle by this. The membrane formation time amount at this time becomes about several seconds and a short thing.

[0035] Next, RF output from the RF power source 15 is suspended, the vacuum bulb 16 is closed and supply of material gas is suspended. Then, the vacuum bulb 18 is opened and the hydrocarbon gas in the vacuum chamber 6 and PET bottle 7 is exhausted with a vacuum pump 21. Then, the vacuum bulb 18 is closed and a vacuum pump 21 is suspended. The degree of vacuum in the vacuum chamber at this time is 5x10-3Torr – 5x10-2Torr. Then, the DLC film is formed in two or more PET bottles by opening the vacuum bulb 17 and repeating the membrane formation approach which carried out atmospheric-air disconnection and mentioned above the inside of the vacuum chamber 6.

[0036] an approach which was mentioned above -- the PET bottle (for example, ten PET bottles) of a predetermined number -- after forming the DLC film to each interior, ashing removes the DLC film which adhered to the front face of an internal electrode 9 using the plasma O2 cleaning device. Then, the process which forms the DLC film in a PET bottle by the approach mentioned above is resumed.

[0037] Next, the concrete approach of the above-mentioned ashing is explained. After removing PET bottle 7 from the vacuum chamber 6, the up electrode 2 is equipped with the lower electrode 1 in the condition of not containing a PET bottle, and the inside of the external electrode 3 is sealed with O ring 8. Thereby, the space in an external electrode will be in the condition that nothing is put in.

[0038] Next, by operating a vacuum pump 21, the inside of a vacuum chamber (space in an external electrode and space in a covering device) is exhausted, and let the inside of a vacuum chamber be a vacuum. Next, after suspending a vacuum pump 21, the vacuum bulb 24 is opened and control of flow of the oxygen gas supplied from the oxygen supply 26 is carried out with a massflow controller 25. And the oxygen gas by which control of flow was carried out is blown off from gas diffuser 9a through the internal electrode 9 of piping 23 and 10 and ground potential. Thereby, oxygen gas is introduced in a vacuum chamber. And the inside of a vacuum chamber is maintained at the controlled oxygen gas flow rate and the pressure which was suitable for ashing with the balance of exhaust air capacity.

[0039] Then, RF output is supplied to the external electrode 3 from the RF power source 15 through a matching box 14. Thereby, O2 plasma is lit between the external electrode 3 and an internal electrode 9, and O2 plasma is generated. Under the present circumstances, since the DLC film adhering to the outside surface of an internal electrode is film which consists of carbon and hydrogen, the reaction of the following type (1) occurs, it is decomposed by O2 cleaning with oxygen and that DLC film is removed. For example, the amount of hydrogen is 2C4H+9O2->8CO2+H2O with the DLC film of 25 atom %. (1)

[0040] Next, RF output from the RF power source 15 is suspended, the vacuum bulb 24 is closed and supply of material gas is suspended. Next, the vacuum bulb 18 is opened and O2 and CO2 in the vacuum chamber 6, and H2O are exhausted with a vacuum pump 21.

[0041] According to the gestalt of the above-mentioned implementation, after arranging O2 cleaning device to CVD membrane formation equipment and carrying out DLC membrane formation of the count of predetermined, it can prevent the DLC film adhering to an internal electrode 9 separating, and falling into a PET bottle by performing O2 cleaning. Therefore, the PET bottle does not serve as a defective with the DLC film which fell into the PET bottle like conventional CVD membrane formation equipment.

[0042] Moreover, since O2 cleaning device is arranged to CVD membrane formation equipment, even if it does

not disassemble equipment like conventional CVD membrane formation equipment, the DLC film adhering to an internal electrode 9 is removable by ashing. Therefore, although it was required for cleaning of an internal electrode with conventional CVD membrane formation equipment on the 1st, the amount required for the cleaning can be reduced sharply. When experimented concretely, after carrying out ten DLC membrane formation, the DLC film adhering to the front face of an internal electrode 9 was able to be finely exfoliated by performing O2 cleaning by the same time amount as DLC membrane formation.

[0043] In addition, although ashing has removed the DLC film which adhered to the front face of an internal electrode 9 using O2 cleaning device which consists of an oxygen supply 26 and massflow controller 25 grade with the gestalt of the above-mentioned implementation It is also possible to use other gas, if it is not limited to oxygen gas as gas for cleaning but has a cleaning action. For example, it is also possible to use the mixed gas of the mixed gas of O2 and Ar, the etching gas of a fluorine system, or O2 gas and the etching gas of a fluorine system. As etching gas of a fluorine system, it is also possible to use CH2F2, CF4, and SiF6 grade, for example.

[0044] That is, the gas for cleaning is introduced in a vacuum chamber by carrying out control of flow of the gas for cleaning supplied from sources of gas supply, such as mixed gas of the mixed gas of O2 and Ar, the etching gas of a fluorine system, and O2 gas and the etching gas of a fluorine system, with a massflow controller 25, and making this gas blow off from gas diffuser 9a through the internal electrode 9 of piping 23 and 10 and ground potential. And by maintaining the inside of a vacuum chamber at the pressure suitable for ashing, and supplying RF output to the external electrode 3 from the RF power source 15 through a matching box 14, the plasma is lit between the external electrode 3 and an internal electrode 9, and the plasma is generated. Thereby, the DLC film adhering to the outside surface of an internal electrode is disassembled.

[0045] Moreover, it is possible for this invention not to be limited to the gestalt of the above-mentioned implementation, but to change variously, and to carry out. For example, it is also possible for it not to be restricted to the generation source of hydrocarbon gas, but to use various generation sources as a material gas generation source, for example, it is also possible to use Si content hydrocarbon system gas etc.

[0046] Moreover, although the PET bottle of a bevel use is used for the interior with the gestalt of this operation as a container which forms a thin film, it is also possible to use the container used for other applications.

[0047] Moreover, although the DLC film or the Si content DLC film is mentioned with the gestalt of this operation as a thin film which forms membranes with CVD membrane formation equipment, in case other thin films are formed in a container, it is also possible to use the above-mentioned CVD membrane formation equipment.

[0048]

[Effect of the Invention] As explained above, according to this invention, the plasma is generated between an internal electrode and an external electrode, and ashing can remove the thin film adhering to an internal electrode. Therefore, the CVD membrane formation equipment and the CVD membrane formation approach of preventing that the thin film adhering to an internal electrode separates and falls into a container, and controlling decline in the operating ratio of equipment can be offered.

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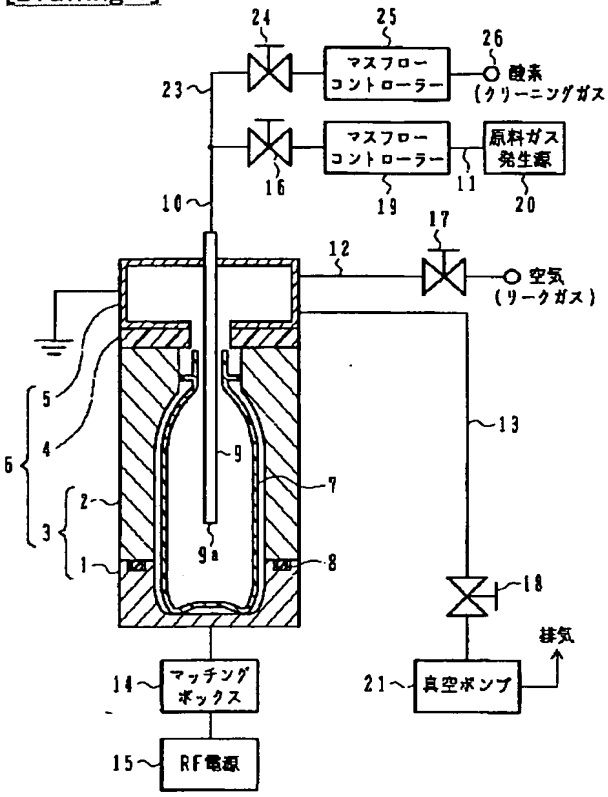
DRAWINGS

[Drawing 1]



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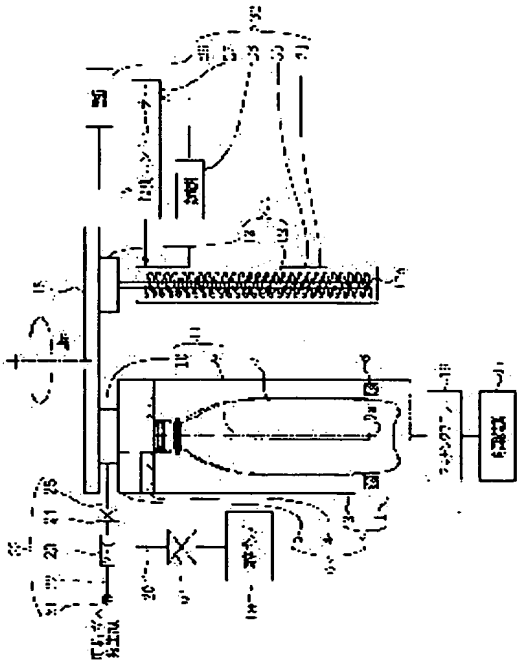
(54) METHOD AND APPARATUS FOR CONTINUOUSLY FORMING DLC FILM IN PLASTIC CONTAINER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an apparatus capable of continuously forming DLC in a plastic container by providing a cleaning part to burn/decompose a foreign matter stuck to the internal electrode.
SOLUTION: The apparatus, which conducts film forming of a DLC (diamond like carbon) film on the inside of a plastic container, is provided with an external electrode part consisting of one or more of external electrodes to encircle a neighborhood of an outside of the plastic container, an internal electrode part arranged with an internal electrode so as to be in relatively inserting into/taking out relation for respective containers, a raw material gas introduction means to introduce a raw material gas into the plastic container, a matching unit connected to the external electrode part, and a cleaning part which is in relatively inserting/taking out relation for a high frequency power source connected to the matching unit and the internal electrode and which is equipped with a furnace chamber to burn/decompose the foreign matter stuck to the internal electrode.



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CLAIMS

[Claim(s)]
[Claim 1] In the equipment which forms the DLC (diamond-like carbon) film inside a plastic envelope The external polar zone constituted with one or more external electrodes arranged so that it may surround near the outside of this plastic envelope, The internal electrode section equipped with the internal electrode arranged so that it may become insertion-and-detachment relation relatively [interior / of this each plastic envelope], A material gas installation means to introduce material gas into the interior of this plastic envelope, The matching unit connected to this external polar zone, and the RF generator connected to this matching unit, DLC film continuation membrane formation equipment into the plastic envelope characterized by having an insertion-and-detachment relation relatively [internal electrode / said], and providing the cleaning section equipped with the furnace room which carries out combustion decomposition and removes the foreign matter adhering to said internal electrode.
[Claim 2] The external polar zone constituted with one or more external electrodes arranged in the equipment which forms the DLC film inside a plastic envelope so that it may surround near the outside of this plastic envelope, The internal electrode section equipped with the internal electrode arranged so that it may become insertion-and-detachment relation relatively [interior / of this each plastic envelope], at least 1 or more sets equivalent to this internal electrode section -- cyclic -- arrangement -- with the exchangeable reserve internal electrode section A material gas installation means to introduce material gas into the interior of this plastic envelope, The matching unit connected to this external polar zone, and the RF generator connected to this matching unit, DLC film continuation membrane formation equipment into the plastic envelope characterized by having an insertion-and-detachment relation relatively [internal electrode / said], and providing the cleaning section equipped with the furnace room which carries out combustion decomposition and removes the foreign matter adhering to said internal electrode.
[Claim 3] [whether 1 or more sets of external polar zone which has the space which contains two or more plastic envelopes constitutes the external polar zone arranged so that it may surround near the outside of said plastic envelope, and] Or 2 or more sets of external polar zone which has the space for containing one plastic envelope constitutes. It is DLC film continuation membrane formation equipment into the plastic envelope according to claim 1 or 2 characterized by having equipped said internal electrode section with the internal electrode of the number of plastic envelopes, and the same number, and equipping said cleaning section with the furnace room of the number of plastic envelopes, and the same number.
[Claim 4] Arrange the internal electrode of ground potential inside a container, and the external polar zone is arranged to the exterior of this container. By supplying material gas in a container, supplying a RF output to the external polar zone, and generating the material gas system plasma between an internal electrode and the external polar zone After performing once the process which forms the DLC film to the inside of a plastic envelope, Or the DLC film continuation membrane formation approach into the plastic envelope characterized by carrying out combustion decomposition and removing by heating this internal electrode under the gas ambient atmosphere which contains oxygen gas or oxygen for the foreign matter which adhered to the internal electrode on the occasion of said process after repeating said process two or more times.
[Claim 5] Arrange the internal electrode of ground potential inside a container, and the external polar zone is arranged to the exterior of this container. By supplying material gas in a container, supplying a RF output to the external polar zone, and generating the material gas system plasma between an internal electrode and the external polar zone Whenever it performs once the process which forms the DLC film to the inside of a plastic envelope, or whenever it repeats said process two or more times, arrangement exchange of the reserve internal electrode section and the internal electrode section which are standing by in a membrane formation process is carried out cyclically. The DLC film continuation membrane formation approach into the plastic envelope characterized by carrying out combustion decomposition and removing by heating this internal electrode under the gas ambient atmosphere which contains oxygen gas or oxygen for the foreign matter adhering to the internal

electrode of the internal electrode section.
[Claim 6] The removal conditions by combustion disassembly of the foreign matter adhering to an internal electrode The conditions which put the internal electrode into the furnace interior of a room of the cleaning section which is a gas ambient atmosphere containing oxygen gas or oxygen, and was held at 600 degrees C or more more than for 3 minutes, and heat it, Or the DLC film continuation membrane formation approach into the plastic envelope according to claim 4 or 5 characterized by being the conditions heated more than for 3 minutes after putting said internal electrode into the furnace interior of a room of the cleaning section of the gas ambient atmosphere containing oxygen gas or oxygen and carrying out a temperature up to 600 degrees C or more.
[Claim 7] Whenever [furnace temperature / for combustion decomposition to remove the foreign matter adhering to an internal electrode] The exoergic section which can keep it warm at 600 degrees C or more, Opening which can put in this internal electrode, and the bleeder which can flow external air by the convection current, The stripper of the foreign matter adhering to the internal electrode characterized by providing the power unit connected with the temperature control means for controlling whenever [furnace temperature / of a ********** room and this furnace room] at this exoergic section.
[Claim 8] Whenever [furnace temperature / for combustion decomposition to remove the foreign matter adhering to an internal electrode] The exoergic section which can keep it warm at 600 degrees C or more, The furnace room equipped with opening which can put in this internal electrode, and a gas supply means by which the gas containing oxygen gas or oxygen can be made to flow into this furnace interior of a room compulsorily, The stripper of the foreign matter adhering to the internal electrode characterized by providing the power unit connected with the temperature control means for controlling whenever [furnace temperature / of this furnace room] at this exoergic section.
[Claim 9] The stripper of the foreign matter adhering to the internal electrode according to claim 7 or 8 characterized by having the furnace room of the total of the internal electrode provided in said internal electrode section, and the same number.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is the membrane formation equipment and the manufacture approach of forming the DLC film inside a plastic envelope, and relates to the stripper of the foreign matter which adhered to the internal electrode at the DLC film continuation membrane formation equipment into the plastic envelope equipped with the cleaning device for combustion decomposition to remove the foreign matter adhering to especially an internal electrode and the continuation membrane formation approach, and the list.
[0002]
[Description of the Prior Art] in order to vapor-deposit the DLC (diamond-like carbon) film to the inside of a plastic envelope for the purpose of improvement, such as gas barrier property, -- CVD (Chemical Vapor Deposition, chemical vapor deposition) -- the vacuum evaporationo equipment using law, especially a plasma-CVD method is indicated by JP,8-53117,A. Moreover, the manufacturing installation for mass production and its manufacture approach of a DLC film coating plastic envelope are indicated by JP,10-258825,A. Furthermore, the manufacturing installation which can coat with the DLC film without a mottling the container which has the excrescence which projects in the method of outside from external surface, and its manufacture approach are indicated by JP,10-226884,A.
[0003] This DLC film is i carbon film or hydrogenation amorphous carbon film (a-C:H). It is the thing of the film called and the hard carbon film is also contained. Moreover, the DLC film is an amorphous-like carbon film, and also has SP3 association. Si content hydrocarbon system gas is used as material gas which forms the Si content DLC film, using hydrocarbon system gas as material gas which forms this DLC film. By forming such DLC film in the internal surface of a plastic envelope, the container usable as containers, such as a carbonated drink and a foaming drink, has been obtained.
[0004]
[Problem(s) to be Solved by the Invention] By the way, in the manufacturing installation of the above-mentioned conventional DLC film coating plastic envelope, if the DLC film is formed to the inside of a PET bottle, the foreign matter (henceforth "the foreign matter adhering to an internal electrode") of the shape of film which uses carbon as a principal component will adhere also to the outside surface and internal surface of an internal electrode. For this reason, the thickness of the foreign matter which adhered to the internal electrode when membrane formation of the DLC film into two or more PET bottles was repeated becomes thick gradually, and if it becomes thickness (for example, thickness of about 5 micrometers) with that thickness, it will separate and will fall from an internal electrode. It separates, and with the foreign matter which fell into the PET bottle, consequently fell into the PET bottle, the part which is not formed in that PET bottle will arise, and this foreign matter that fell will reduce gas barrier property, and will become a defective.
[0005] The following approach can be considered to prevent that the foreign matter adhering to an internal electrode separates and falls into a PET bottle on the other hand. That is, it is the approach are before the foreign matter adhering to an internal electrode separates and falls, and an operator does deleting by the file etc. and cleans the outside surface and internal surface of the internal electrode to which the manufacturing installation of a DLC film coating plastic envelope was decomposed, the internal electrode was removed, and the foreign matter has adhered after forming the DLC film in the PET bottle of a certain amount of number. Thus, if the outside surface and internal surface of an internal electrode are cleaned, it should be able to prevent that a foreign matter separates and falls into a PET bottle.
[0006] If such an approach is used, it can be prevented that the foreign matter adhering to an internal electrode separates and falls into a PET bottle. However, the operating ratio fall of the DLC film membrane formation equipment into a plastic envelope will be caused.
[0007] Especially the place that it is made since this invention completely does not produce the equipment operating ratio fall by the dirt of an internal electrode ultimately in order to prevent the operating ratio fall of the

DLC film membrane-formation equipment into the above-mentioned plastic envelope, and makes into the purpose is by providing the cleaning [redacted]ion which understands the foreign ma[redacted] adhering to an internal electrode a burned part to offer the DLC film continuation membrane-formation equipment into a plastic envelope.

[0008] In addition, with the container concerning this invention, a lid, a plug, the container used carrying out a seal, or the container used in the state of opening without them is included. The magnitude of opening is decided according to contents. A plastic envelope contains the plastic envelope which has the predetermined thickness which has rigidity moderately, and the plastic envelope formed of the web material which does not have rigidity. Packing of the plastic envelope concerning this invention can mention drugs, an agricultural-chemicals article, or the dried food that dislikes moisture absorption to a carbonated drink, a fruit-juice drink or drinks, such as a soft drink, and a list.

[0009] The 2nd purpose is combustion decomposition removing the foreign matter adhering to an internal electrode as a matter of fact, and not producing an equipment operating ratio fall.

[0010] The 3rd purpose is making it possible to twist at once tailing of a total of several lines of two or more internal electrodes which make it possible to coat the DLC film at coincidence at two or more plastic envelopes, and constitute the internal electrode section.

[0011] The 4th purpose is to offer the approach of carrying out continuation membrane formation of the DLC film into a plastic envelope.

[0012] The 5th purpose removes the foreign matter adhering to an internal electrode by combustion decomposition as a matter of fact, and is to offer the continuation membrane formation approach of the DLC film into the plastic envelope which does not produce an equipment operating ratio fall.

[0013] The 6th purpose proposes the optimal heating conditions of removal by combustion disassembly of the foreign matter adhering to an internal electrode, and is to make it the combustion decomposition process of a foreign matter not cause an equipment availability fall.

[0014] The customer who the 7th purpose offers the stripper of the foreign matter adhering to an internal electrode, and owns two or more membrane formation equipments of the DLC film is making it possible to remove the foreign matter adhering to an internal electrode by combustion decomposition by plant-and-equipment investment of a small sum.

[0015] The 8th purpose is offering the stripper of the foreign matter adhering to the internal electrode which can perform still more efficiently combustion disassembly of the foreign matter adhering to an internal electrode by making the gas containing oxygen gas or oxygen flow into the furnace interior of a room compulsorily.

[0016] The 9th purpose is offering the stripper of the foreign matter adhering to the internal electrode which can twist at once tailing of a total of several lines of two or more internal electrodes which constitute the internal polar zone.

[0017]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the DLC film continuation membrane formation equipment into the plastic envelope concerning this invention The external polar zone constituted with one or more external electrodes arranged in the equipment which forms the DLC film inside a plastic envelope so that it may surround near the outside of this plastic envelope, The internal electrode section equipped with the internal electrode arranged so that it may become insertion-and-detachment relation relatively [interior / of this each plastic envelope], A material gas installation means to introduce material gas into the interior of this plastic envelope, It is characterized by providing the cleaning section equipped with the furnace room which carries out combustion decomposition and removes the matching unit connected to this external polar zone, the RF generator connected to this matching unit, and the foreign matter which has an insertion-and-detachment relation relatively [internal electrode / said], and adhered to said internal electrode.

[0018] The DLC film continuation membrane formation equipment into the plastic envelope concerning this invention The external polar zone constituted with one or more external electrodes arranged in the equipment which forms the DLC film inside a plastic envelope so that it may surround near the outside of this plastic envelope, The internal electrode section equipped with the internal electrode arranged so that it may become insertion-and-detachment relation relatively [interior / of this each plastic envelope], at least 1 or more sets equivalent to this internal electrode section -- cyclic -- arrangement -- with the exchangeable reserve internal electrode section A material gas installation means to introduce material gas into the interior of this plastic envelope, It is desirable to provide the cleaning section equipped with the furnace room which carries out combustion decomposition and removes the matching unit connected to this external polar zone, the RF generator connected to this matching unit, and the foreign matter which has an insertion-and-detachment relation relatively [internal electrode / said], and adhered to said internal electrode.

[0019] With the DLC film continuation membrane formation equipment into the plastic envelope concerning this

invention [whether 1 or more sets of external polar zone which has the space which contains two or more plastic envelopes constitutes the external polar zone arranged so that it may [redacted]ound near the outside of said plastic envelope, and] Or 2 or more sets of external polar zone which has the space for containing one plastic envelope constitutes, and said internal electrode section is equipped with the internal electrode of the number of plastic envelopes, and the same number, and, as for said cleaning section, it is still more desirable to have had the furnace room of the number of plastic envelopes and the same number. DLC film vacuum evaporationo process time amount determines the number of groups of the reserve internal electrode section. It is because it will become impossible to fully take the time amount for tailing if DLC film vacuum evaporationo process time amount can be shortened.

[0020] moreover, by the DLC film continuation membrane formation approach into the plastic envelope concerning this invention Arrange the internal electrode of ground potential inside a container, and the external polar zone is arranged to the exterior of this container. By supplying material gas in a container, supplying a RF output to the external polar zone, and generating the material gas system plasma between an internal electrode and the external polar zone After performing once the process which forms the DLC film to the inside of a plastic envelope, Or after repeating said process two or more times, it is characterized by carrying out combustion decomposition and removing by heating this internal electrode under the gas ambient atmosphere which contains oxygen gas or oxygen for the foreign matter which adhered to the internal electrode on the occasion of said process.

[0021] By the DLC film continuation membrane formation approach into the plastic envelope furthermore applied to this invention Arrange the internal electrode of ground potential inside a container, and the external polar zone is arranged to the exterior of this container. By supplying material gas in a container, supplying a RF output to the external polar zone, and generating the material gas system plasma between an internal electrode and the external polar zone Whenever it performs once the process which forms the DLC film to the inside of a plastic envelope, or whenever it repeats said process two or more times, arrangement exchange of the reserve internal electrode section and the internal electrode section which are standing by in a membrane formation process is carried out cyclically. It is desirable to carry out combustion decomposition and to remove by heating this internal electrode under the gas ambient atmosphere which contains oxygen gas or oxygen for the foreign matter adhering to the internal electrode of the internal electrode section.

[0022] After it puts the conditions which put said internal electrode into the furnace interior of a room of the cleaning section which is a gas ambient atmosphere containing oxygen gas or oxygen, and was held at 600 degrees C or more more than for 3 minutes, and are heated by the DLC film continuation membrane-formation approach into the plastic envelope concerning this invention, or said internal electrode into the furnace interior of a room of the cleaning section of the gas ambient atmosphere containing oxygen gas or oxygen and it carries out a temperature up to 600 degrees C or more, it is desirable that they are the conditions heated more than for 3 minutes.

[0023] The stripper of the foreign matter adhering to the internal electrode concerning this invention Whenever [furnace temperature / for combustion decomposition to remove the foreign matter adhering to an internal electrode] The exoergic section which can keep it warm at 600 degrees C or more, It is characterized by providing the power unit connected with the temperature control means for controlling whenever [furnace temperature / of the furnace room equipped with opening which can put in this internal electrode, and the bleeder which can flow external air by the convection current, and this furnace room] at this exoergic section.

[0024] The stripper of the foreign matter adhering to the internal electrode furthermore built over this invention Whenever [furnace temperature / for combustion decomposition to remove the foreign matter adhering to an internal electrode] The exoergic section which can keep it warm at 600 degrees C or more, The furnace room equipped with opening which can put in this internal electrode, and a gas supply means by which the gas containing oxygen gas or oxygen can be made to flow into this furnace interior of a room compulsorily, It is desirable to provide the power unit connected with the temperature control means for controlling whenever [furnace temperature / of this furnace room] at this exoergic section.

[0025] As for the stripper of the foreign matter adhering to the internal electrode concerning this invention, it is still more desirable to have the furnace room of the total of the internal electrode provided in said internal electrode section and the same number.

[0026]

[Embodiment of the Invention] One gestalt of operation of this invention is explained based on drawing 1 below. The DLC film continuation membrane formation equipment into the plastic envelope by the gestalt of operation of this invention is equipment which forms the DLC film or the Si content DLC film to the insides, such as a container, using a plasma-CVD method.

[0027] The DLC film continuation membrane formation equipment into the plastic envelope concerning this

invention possesses the external polar zone 3, the internal electrode section 11, the reserve internal electrode section 14, the material gas installation means 33, a matching unit 16, RF generator 17, and the cleaning section 32 for combustion decomposition to remove the foreign matter adhering to an internal electrode.
[0028] The external polar zone 3 constitutes the vacuum chamber 6 with a conductive covering device 5 and a conductive insulating member 4. The insulating member 4 is arranged under the covering device 5, and the external polar zone 3 is arranged under this insulating member 4. This external polar zone 3 consists of an up external electrode 2 and a Shimobe external electrode 1, and it is constituted so that the upper part of the Shimobe external electrode 1 may be attached in the lower part of the up external electrode 2 free [attachment and detachment] through O ring 8. Moreover, the external electrode 3 is insulated with the covering device 5 by the insulating member 4.
[0029] The external polar zone in the case of coating the inside of plurality, for example, eight plastic envelopes, with the DLC film at coincidence is explained based on drawing 3 which is the mimetic diagram showing instantiation of the sectional view in the field where the Shimobe external electrode 1 and the up external electrodes 2 overlap. Namely, as for drawing 3 (a), when the number of the space where a plastic envelope is contained is plurality and consists only of 1 set of external electrodes, the number of the space where a plastic envelope is contained is plurality, the number of the space where a plastic envelope is contained is one, and, as for drawing 3 (c), drawing 3 (b) shows the case where the number of plastic envelopes and the group of an external electrode are the same numbers, when consisting of 2 sets of external electrodes. In this invention, which case is sufficient among these three gestalten, and a case so that it may have 4 sets of external polar zone which can contain two plastic envelopes as another gestalt of drawing 3 (b) further is sufficient.
[0030] In addition, although the external polar zone 3 is divided into two, the Shimobe external electrode 1 and the up external electrode 2, with this operation gestalt Dividing the external polar zone more than three or it like for example, a pars-basilaris-ossis-occipitalis electrode, a drum section electrode, and a shoulder electrode, and each electrode securing seal nature on both sides of an O ring etc., in order to attain equalization of the thickness of the DLC film etc. You may insulate electrically with a Teflon (trademark) sheet or a polyimide film.
[0031] Space is formed in the interior of the external electrode 3, and this space is for holding PET bottle 7 which is the plastic envelope for coating, for example, the container made of polyethylene terephthalate resin. The space in the external polar zone 3 is formed so that it may become large slightly rather than the appearance of PET bottle 7 held there. Opening connected with the space in an external electrode is prepared in the insulating member 4 and the covering device 5. Moreover, space is established in the interior of a covering device 5, and this space is connected with the space in the external polar zone 3 through the above-mentioned opening. The space in the external polar zone 3 is sealed from the outside with O ring 8 arranged between the up external electrode 2 and the Shimobe external electrode 1.
[0032] The impedance matching box (matching unit) 16 is connected to the Shimobe external electrode 1. Furthermore, the matching unit 16 is connected to RF generator (RF power source) 17 through the coaxial cable.

[0033] It is constituted so that the internal electrode base material 10 may support an internal electrode 9, and an internal electrode 9 is arranged in the external polar zone 3, and the internal electrode section 11 is arranged inside a plastic envelope 7. That is, it lets the space in a covering device 5, and a covering device 5 and opening of an insulating member 4 pass from the upper part of a covering device 5, and the internal electrode 9 is fitted over the space in the external polar zone 3. That is, the end face of an internal electrode 9 is arranged in the upper part of a covering device 5, and the inferior surface of tongue of the internal electrode base material 10 and the top face of a covering device 5 are arranged so that a plane of composition may be carried out. On the other hand, tip 9a of an internal electrode 9 is arranged inside PET bottle 7 which is the space in the external polar zone 3, and was held in the external polar zone 3. The internal electrode 9 has the tubing configuration which the interior becomes from hollow. Gas blowdown RO 9a is prepared at the tip of an internal electrode 9.
[0034] The reserve internal electrode section 14 consists of configurations equivalent to the internal electrode section 11, i.e., an internal electrode 12 and the internal electrode base material 13. Gas diffuser 12a is prepared by the internal electrode 12 like the internal electrode 9. It is fixed so that it may be contrasted to the center of rotation of the rotation susceptor 15, and the internal electrode section 11 and the reserve internal electrode section 14 have come to be able to perform arrangement exchange cyclically.
[0035] In addition, although the reserve internal electrode section 14 is made into 1 set with this operation gestalt, the rotation susceptor 15 may be equipped with 2 or more sets of reserve internal electrode sections if needed.
[0036] The material gas installation means 33 introduces the material gas supplied to the interior of a plastic envelope 7 from the material gas generation source 21. That is, the one side of piping 25 is connected to the end face of an internal electrode 9 through the internal electrode base material 10, and the other side of this piping

25 is connected to the one side of a massflow controller 23 through the vacuum bulb 24. The other side of a massflow controller 23 is connected to the material gas generation source 21 through piping 22. This material gas generation source 21 generates hydrocarbon gas, such as acetylene, etc. In addition, when arrangement exchange of the location of the internal electrode section 11 and the reserve polar zone 14 is carried out cyclically, material gas is supplied to the internal electrode base material 14 as well as the internal electrode base material 10 through piping 25.

[0037] The space in a covering device 5 is connected to the one side of piping 20, and the other side of piping 20 is connected to the vacuum pump 18 through the vacuum bulb 19. This vacuum pump 18 is connected to the exhaust side.

[0038] The cleaning section 32 for combustion decomposition to remove the foreign matter adhering to an internal electrode is equipped with the furnace room further constituted by the temperature measurement sections 28, such as the combustion tube 30 around which the exoergic coil 31 connected with the temperature controller, the temperature control means 27, i.e., the temperature controller, which receives supply of a power source 26 and, 27 through the electric wire was wound, and a thermocouple connected to the temperature controller 27. The temperature measurement sections 28, such as a thermocouple, are arranged inside the combustion tube 30. The bleeder (un-illustrating) for supplying air to the combustion tube 30 by the convection current is prepared, and, as for the quality of the material of the combustion tube, it is desirable that they are heat-resisting material, such as stainless steel or ceramics.

[0039] In addition, the combustion tube for removing the foreign matter adhering to an internal electrode is instantiation, if a foreign matter is removable with combustion decomposition, may be burner heating, optical heating, or energization heating of an internal electrode, and will not be restricted to the combustion tube explained here, for example. Piping which supplies the gas containing oxygen, such as oxygen gas or air, may be connected to the combustion tube 30.

[0040] Next, how to form the DLC film inside a container using the DLC film continuation membrane formation equipment into the plastic envelope shown in drawing 1 is explained.

[0041] First, a vacuum bulb (un-illustrating) is opened and atmospheric-air disconnection of the inside of the vacuum chamber 6 is carried out. Thereby, air goes into the space in a covering device 5, and the space in the external polar zone 3, and the inside of the vacuum chamber 6 is made into atmospheric pressure. Next, the Shimobe external electrode 1 of the external polar zone 3 is removed from the up external electrode 2, and PET bottle 7 is inserted and installed in the space in the up external electrode 2 from the up external electrode 2 bottom. Under the present circumstances, it will be inserted by the internal electrode 9 into PET bottle 7. Next, the lower part of the up external electrode 2 is equipped with the Shimobe external electrode 1, and the external electrode 3 is sealed with O ring 8.

[0042] Then, after closing a vacuum bulb (un-illustrating), the vacuum bulb 19 is opened and a vacuum pump 18 is operated. The inside of the vacuum chamber 6 including the inside of PET bottle 7 is exhausted through piping 20 by this, and the inside of the vacuum chamber 6 serves as a vacuum. The pressure in the vacuum chamber 6 at this time is 5x10-3 - 5x10-2Torr.

[0043] Next, the vacuum bulb 24 is opened, hydrocarbon gas is generated in the material gas generation source 21, this hydrocarbon gas is introduced in piping 22, and the hydrocarbon gas by which control of flow was carried out with the massflow controller 23 is blown off from gas blowdown RO9a through the internal electrode 9 of piping 25 and ground potential. Thereby, hydrocarbon gas is introduced in PET bottle 7. And the inside of the vacuum chamber 6 and PET bottle 7 is maintained at the controlled quantity of gas flow and the pressure (for example, 0.05 - 0.5Torr extent) which was suitable for DLC membrane formation with the balance of exhaust air capacity.

[0044] Then, RF output (for example, 13.56MHz) is supplied to the external electrode 3 from RF generator (RF power source) 17 through a matching unit 16. This lights the plasma between the external electrode 3 and an internal electrode 9. At this time, the matching unit 16 is doubled with the impedance of an external electrode and an internal electrode with an inductance L and capacitance C. The hydrocarbon system plasma occurs in PET bottle 7, and the DLC film is formed inside PET bottle 7 by this. The membrane formation time amount at this time becomes about several seconds and a short thing.

[0045] Next, RF output from RF generator 17 is suspended, the vacuum bulb 24 is closed and supply of material gas is suspended. Then, the vacuum bulb 19 is opened and the hydrocarbon gas in the vacuum chamber 6 and PET bottle 7 is exhausted with a vacuum pump 18. Then, the vacuum bulb 19 is closed and a vacuum pump 18 is suspended. The pressure in the vacuum chamber 6 at this time is 5x10 - 5x10-2Torr. Then, the DLC film is formed in the following PET bottle by opening a vacuum bulb (un-illustrating) and repeating the membrane formation approach which carried out atmospheric-air disconnection and mentioned above the inside of the vacuum chamber 6.

[0046] After repeating membrane formation of the DLC film the count of predetermined (for example, 60 times) to the wall of PET bottle 7 by approach which was mentioned above, the rotation susceptor 15 is moved up, the rotation susceptor 15 is rotated, the rotation susceptor 15 is again moved caudad to the height of a basis, and arrangement exchange of the arrangement of the internal electrode section 11 and the reserve internal electrode section 14 is carried out cyclically. The membrane formation activity of the above-mentioned DLC film is continued using the internal electrode section 11 (internal electrode section which was the reserve internal electrode section 14 before arrangement exchange was carried out cyclically) which carried out arrangement exchange. Although only the time amount which carried out arrangement exchange of the arrangement of the internal electrode section 11 and the reserve internal electrode section 14 is needed for an excess from the usual working hours at this time, since this time amount is very a short time, the factor which reduces an operating ratio does not become as a matter of fact.

[0047] On the other hand, it is used for membrane formation of the DLC film till then, the internal electrode 12 of the reserve internal electrode section 14 (internal electrode section which was the internal electrode section 11 before arrangement exchange was carried out cyclically) used as a reserve is inserted in the interior of the combustion tube 30, and the foreign matter adhering to an internal electrode 12 is removed by carrying out combustion decomposition by actuation of the cleaning section 32.

[0048] Next, the concrete approach of the above-mentioned combustion decomposition removal is explained. Arrangement exchange of the internal electrode section which carried out the upper theory is carried out cyclically, and an internal electrode 12 is inserted in the combustion tube 30. Next, a temperature up is carried out, performing temperature control in the combustion tube 30 by the temperature controller 27 based on the temperature value which measured the current in a sink and the temperature measurement section 28 in the exoergic coil 31. A temperature controller 27 is programmed to carry out a temperature up and to be heated to 650 degrees C at 120 degrees C/m.

[0049] After an internal electrode 12 is inserted in the combustion tube 30 as mentioned above, before the internal electrode 12 besides the approach of starting the temperature up in the combustion tube 30 is inserted in the combustion tube 30, the combustion tube 30 is beforehand heated to predetermined temperature, for example, 650 degrees C, and the temperature control of a temperature controller 27 may be programmed to insert an internal electrode 12 into the combustion tube 30 of a heating condition.

[0050] By heating an internal electrode 12 by the cleaning section 32 650 degrees C before [temperature up / 5 minutes / heating / 12 minutes] 650 degrees C, the foreign matter adhering to an internal electrode front face carries out combustion decomposition, and is removed. In addition, since air is supplied to the combustion tube 30 by the free convection from a bleeder, when combustion decomposition of the foreign matter is carried out by this oxygen, it is thought that a carbon dioxide generates.

[0051] After the foreign matter adhering to an internal electrode 12 carries out combustion decomposition, a temperature controller 27 performs temperature control so that the current which flows in the exoergic coil 31 may be stopped.

[0052] With the operation gestalt of this invention, although he left supply of air to the free convection, a gas supply means is established, in the combustion tube, the flow of the air may be carried out, it may be supplied, the flow of the oxygen gas may be carried out and it may be supplied.

[0053] The internal electrode 12 from which the foreign matter was removed is made to stand by until it carries out arrangement exchange of the arrangement of the internal electrode section 11 and the reserve internal electrode section 14 cyclically again through the membrane formation process of the DLC film the number of predetermined times. By repeating the above process, the operating ratio fall of the equipment which originates in tailing adhering to an internal electrode as a matter of fact can be lost.

[0054] In addition, without having a reserve internal electrode and rotation susceptor, although this operation gestalt explained equipment equipped with the reserve internal electrode section 14, after a foreign matter carries out specified-quantity adhesion, the furnace room of the cleaning section 32 may be moved to an internal electrode 9, the function it inserts [function] to an internal electrode 9 may be given, and the configuration of equipment from which combustion decomposition is carried out and the foreign matter adhering to the internal electrode is removed may be taken.

[0055] Moreover, although this operation gestalt explained according to the equipment of PET bottle 1 bookstand, as shown in drawing 2 , it is also applicable [two or more PET bottles] to the membrane formation equipment with which coincidence can be coated like the membrane formation equipment of PET bottle 8 bookstand.

[0056] Moreover, it is possible for this invention not to be limited to the gestalt of the above-mentioned implementation, but to change variously, and to carry out. For example, it is also possible for it not to be restricted to the generation source of hydrocarbon gas, but to use various generation sources as a material gas

generation source, for example, it is also possible to use Si content hydrocarbon system gas etc.
[0057] Moreover, although the PET b[illegible]e of a bevel use is used for the interi[illegible]h the gestalt of this operation as a container which forms a thin film, it is also possible to use the container used for other applications.
[0058] Moreover, although the DLC film or the Si content DLC film is mentioned with the gestalt of this operation as a thin film which forms membranes with CVD membrane formation equipment, in case other thin films are formed in a container, it is also possible to use the above-mentioned membrane formation equipment.
[0059]
[Example] The example which shows the removal conditions by combustion disassembly of the foreign matter adhering to the internal electrode in the cleaning section 32 below explains.
[0060] (Example 1) The internal electrode 9 to which foreign matters, such as DLC, adhered is inserted into the combustion tube 30 of the cleaning section 32. A current is heated for air at sink predetermined time and predetermined temperature in the exoergic coil 31 with a sink in the combustion tube 30 and an internal electrode 9. The internal electrode 9 after heating was taken out and the front face by viewing was observed. In addition, the flow of the conditions shown in the example 1 of Table 1, i.e., the air, was carried out into the combustion tube at a rate of 10l./m to eight internal electrodes, and the internal electrode was heated about 650 degrees C for [for / to 650 degrees C / temperature up / 5 minutes / heating / a total of 15 minute] 10 minutes. The evaluation result at this time was divided in five steps, and was shown in Table 2. As Table 2 showed, the foreign matter adhering to an internal electrode was completely removable with combustion decomposition. When the DLC film was formed using again the internal electrode which furthermore carried out tailing, after that, for 120 minutes, the internal electrode was not influenced of the foreign matter reattachment, but was usable. In addition, when the DLC film was formed using the new internal electrode, after that, for 120 minutes, the internal electrode was not influenced of foreign matter adhesion, but was usable.
[0061]
[Table 1]

	フローガス種類	ガス流量(L/min)	設定温度(℃)	設定温度までの昇温時間(分)	設定温度での加熱時間(分)	加熱合計時間(分)
実施例1	空気	10	650	5	10	15
実施例2	自然対流	0	650	5	5	10
実施例3	自然対流	0	650	5	3	8
実施例4	空気	10	600	4	3	7
実施例5	空気	10	600	0	3	3
実施例6	酸素	10	650	0	3	3
比較例1	アルゴン	6	600	4	10	14
比較例2	空気	10	500	3	10	13
比較例3	アルゴン	5	500	3	10	13

[Table 2]

	評価(優:1～劣:5)	表面状態	
実施例1	1	内外面ともカーボンが完全に除去されている。先端キツネ色。中央部はくすんだ紫色。酸化されている様子。導通あり。	120
実施例2	1	内外面ともカーボンが完全に除去されている。先端キツネ色。中央部はくすんだ紫色。酸化されている様子。導通あり。	120
実施例3	2	外表面は完全に除去されいている。内部にわずかに煤が残っている。先端キツネ色。中央部紫色。導通あり。	110
実施例4	2	内外面ともにカーボンがほぼ除去されている。粉状の煤がわずかに残っている。金属表面はキツネ色。導通あり。	110
実施例5	2	外表面は完全に除去されいている。内部にわずかに煤が残っている。先端キツネ色。中央部紫色。導通あり。	105
実施例6	1	内外面ともカーボンが完全に除去されている。先端キツネ色。中央部はくすんだ紫色。酸化されている様子。導通あり。	120
比較例1	3	外表面のカーボンはほぼ除去されている。粉状の煤がわずかに残っている。内表面は半分ほど除去されている。内面のカーボンは破片になって落下している。金属表面キツネ色。導通あり。	30
比較例2	4	外表面のカーボンは半分ほど除去されている。内表面はほとんど除去されずに残っている。	5
比較例3	5	表面のカーボンが少し薄くなったがほとんど変化なし。	0

[0062] (Examples 2-6) According to the conditions shown in the examples 2-6 of Table 1, the foreign matter which adhered to the internal electrode like the example 1 was removed. The heating up time to each laying

temperature is contained in heating time like the example 1. However, in the examples 5 and 6, since combustion tube temperature was beforehand he[illegible] laying temperature and the internal [illegible]rode was put in into it, the heating up time wrote it as 0 minute excluding the temperature up process. The evaluation result at this time is shown in Table 2. As Table 2 showed, combustion decomposition was able to remove nearly completely the foreign matter which adhered to the internal electrode in examples 2-6. When the DLC film was formed using again the internal electrode which furthermore carried out tailing, about the time amount shown in Table 2, the internal electrode of examples 2-6 was not influenced of the foreign matter reattachment, but was usable. Therefore, a membrane formation equipment operating ratio was not lowered.

[0063] (Example 1 of a comparison) The internal electrode 9 to which foreign matters, such as DLC, adhered is inserted into the combustion tube 30 of the cleaning section 32. A current is heated for air at sink predetermined time and predetermined temperature in the exoergic coil 31 with a sink in the combustion tube 30 and an internal electrode 9. The internal electrode 9 after heating was taken out and the front face by viewing was observed. In addition, the flow of the conditions shown in the example 1 of a comparison of Table 1 to eight internal electrodes, i.e., the argon, was carried out into the combustion tube at a rate of 6l./m, and the internal electrode was heated about 600 degrees C for [for / to 600 degrees C / temperature up / 4 minutes / heating / a total of 14 minute] 10 minutes. The evaluation result at this time is shown in Table 2. As Table 2 showed, the foreign matter adhering to an internal electrode was completely unremovable. When the DLC film was formed using again the internal electrode which furthermore carried out tailing, the effect of the reattachment of a foreign matter began to come out after the 30 minutes, and the internal electrode became unusable. Therefore, it was inadequate to have controlled decline in a membrane formation equipment operating ratio.

[0064] (Examples 2 and 3 of a comparison) According to the conditions shown in the examples 2 and 3 of a comparison of Table 1, the foreign matter which adhered to the internal electrode like the example 1 of a comparison was removed. The heating up time to each laying temperature is contained in heating time as well as the example 1 of a comparison. The evaluation result at this time is shown in Table 2. As Table 2 showed, the foreign matter which adhered to the internal electrode in the examples 2 and 3 of a comparison was completely unremovable. When the DLC film was formed using again the internal electrode which furthermore carried out tailing, the effect of the reattachment of a foreign matter began to appear after the time amount progress shown in Table 2, and the internal electrode of the examples 2 and 3 of a comparison became unusable. Therefore, it was inadequate to have controlled decline in a membrane formation equipment operating ratio.

[0065] Table 2 if it is alike and the result of the shown example and the example of a comparison is compared, a carbon film will be easy to be removed, so that temperature is high. Moreover, if the processing time is lengthened, removal will progress. It is more effective to use air rather than it passes argon gas. this invention persons are conjecturing that in which the combustion reaction by the oxygen in atmospheric air has occurred. In an example 1 and the example 2, since both carbon films are removed nearly completely, even if there is a gas flow of air and there is, it seldom affects carbon film removal. [no] Any internal electrode of an example had all flows, although the outside surface has become purple from light brown and we were anxious about insulation-ization by scaling.

[0066] Irrespective of the existence of heating in a temperature up, that the heating time in laying temperature takes 3 minutes or more more than for the heating time 3 minute in laying temperature at the heating temperature of 650 degrees C or more preferably can call it the conditions for removing a carbon film efficiently at the heating temperature of 600 degrees C or more in atmospheric air from the above result. With heating at 600 degrees C or less, from a viewpoint of a carbonaceous pyrolysis, since it becomes inadequate heating, even if there is a heating process at the time of a temperature up, it will be thought that contribution of the pyrolysis of a foreign matter is small. Moreover, it was possible to have shortened the processing time further by making flow gas into oxygen. Furthermore, it is also possible to carry out required heating time in 3 or less minutes by carrying out the temperature up of the temperature of the combustion tube to laying temperature in advance before internal electrode insertion like an example 5 or 6. Of course, it was also possible on control of a machine to have heated for a long time than such heating time.

[0067] However, what is necessary is just to be able to perform removal by combustion disassembly of a foreign matter within the time amount, and just to choose combustion decomposition conditions so that the energy which heating of the combustion tube takes may decrease since continuous duty of the internal electrode can be carried out for 120 minutes in membrane formation of the DLC film by understanding the foreign matter adhering to an internal electrode a burned part.

[0068]

[Effect of the Invention] According to this invention, the DLC film continuation membrane formation equipment into the plastic envelope which prevented decline in an operating ratio was able to be offered by arranging the

cleaning section. That is, after having arranged the cleaning section to the DLC film continuation membrane formation equipment into a plastic e[redacted]pe and forming the DLC film of the c[redacted] of predetermined, by performing cleaning by combustion decomposition, combustion removal was carried out and the foreign matter adhering to an internal electrode was able to prevent falling into a PET bottle. Therefore, the PET bottle did not become a defective with the foreign matter which fell into the PET bottle like conventional DLC film membrane formation equipment.

[0069] Moreover, even if it did not disassemble equipment like conventional DLC film membrane formation equipment, the foreign matter adhering to an internal electrode was removable. Therefore, although it was required for cleaning of an internal electrode with conventional equipment on the 1st, time amount required for the cleaning was able to be reduced sharply.

[0070] According to this invention, it was also still more possible to have the reserve internal electrode section, to have carried out arrangement exchange and to have provided the internal electrode section and a circulation target with the DLC film continuation membrane formation equipment into the plastic envelope which is not made to completely generate the equipment operating ratio fall by the dirt of an internal electrode ultimately in cleaning the internal electrode of the internal electrode section which is not used.

[0071] According to this invention, by having the internal electrode of the total of the space for containing the plastic envelope of the external polar zone, and the same number, it was possible in coating coincidence with the DLC film at two or more plastic envelopes, and it was possible to have twisted at once tailing of a total of several lines of two or more internal electrodes which constitute the internal electrode section.

[0072] The DLC film continuation membrane formation approach into a plastic envelope is offered by preparing the cleaning section equipped with the furnace room which removes the foreign matter adhering to an internal electrode by combustion decomposition according to this invention. Furthermore, the interior polar zone of a reserve was able to be prepared and the DLC film continuation membrane formation approach into the plastic envelope which does not produce the equipment operating ratio fall by tailing as a matter of fact was able to be offered by cleaning the internal electrode of the internal polar zone which is carrying out arrangement exchange and which is not used for the internal polar zone and a circulation target. Moreover, the optimal heating conditions of removal by combustion disassembly of the foreign matter adhering to an internal electrode are proposed, and the combustion decomposition process of a foreign matter was able to be prevented from becoming the factor of an equipment availability fall.

[0073] Moreover, according to this invention, the customer who owns two or more manufacturing installations of a DLC film coating plastic envelope was able to make it possible to remove the foreign matter adhering to an internal electrode by combustion decomposition by plant-and-equipment investment of a small sum by offering the stripper of the foreign matter adhering to an internal electrode.

[0074] According to this invention, combustion disassembly of the foreign matter adhering to an internal electrode was able to be performed still more efficiently by making the gas containing oxygen gas or oxygen flow into the furnace room with which the stripper of the foreign matter adhering to an internal electrode was equipped compulsorily in the furnace interior of a room.

[0075] Furthermore, according to this invention, tailing of a total of several lines of two or more internal electrodes which constitute the internal polar zone was able to be twisted at once by offering the cleaning equipment which has the combustion tube of the total of the space for containing the plastic envelope of the external polar zone, and the same number.

[Translation done.]